

REMARKS

Claims 18-22 are all the claims presently pending in the application. Claims 18-22 have been amended to more clearly define the invention. Claims 1-17 are canceled. Claims 18-22 are independent.

These amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

Applicant also notes that, notwithstanding any claim amendments herein or later during prosecution, Applicant's intent is to encompass equivalents of all claim elements.

Claims 18-22 stand rejected under 35 U.S.C. § 102(e) as being unpatentable over the Iwamura et al. reference (U.S. Patent No. ,467,865).

This rejection is respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention, as defined by independent claim 18, is directed to a method for driving an ink jet recording head. The method includes applying a driving voltage to an electro-mechanical converter to deform the electro-mechanical converter to thereby change a pressure in the pressure generating chamber filled with ink, thus ejecting ink droplets with a size of about 5 to about 25 μm through a nozzle in communication with the pressure generating chamber. The applying of the driving voltage includes a first voltage changing process which applies a voltage in a direction that increases a volume of the pressure generating chamber, a second voltage changing process which applies a voltage in a direction that reduces the volume of the pressure generating chamber; and a third voltage changing

process which applies a voltage in a direction that increases the volume of said pressure generating chamber again. The voltage changing times t_2 and t_3 during the second and third voltage changing processes have such lengths as shown below, relative to a resonance frequency T_c of a pressure wave generated in the pressure generating chamber being $0 < t_2 < T_c/2$ and $0 < t_3 < T_c/2$. The nozzle has an opening diameter of about 20 to less than 30 μm .
The driving voltage changing times are based upon the resonance frequency.

In summary, while meniscus control may be known, an optimal driving voltage waveform for smaller volume of ink drops (i.e. approximately 10^{-12} liters) in meniscus control did not exist until the present invention. The present invention utilizes pressure waves generated at nodes of the driving voltage waveform to eject a smaller volume ink drop in accordance with optimal rising/falling times of the driving voltage waveform.

Specifically, the present invention controls these pressure waves to eject smaller volume ink drops, by basing the driving voltage changing times upon the resonance frequency.

An exemplary embodiment of the present invention enables small drops by providing a rising time of a second voltage changing process to be less than $T_c/2$, adding a third voltage changing process, the falling time of the third voltage changing process being less than $T_c/2$, and the start time of the third voltage changing process being the end of the second voltage changing process.

II. THE PRIOR ART REJECTION

Regarding the rejection of claims 18-22, the Examiner alleges that the Iwamura et al. reference teaches the claimed invention. Applicant submits, however, that there are elements

of the claimed invention which are neither taught nor suggested by the Iwamura et al. reference.

The Iwamura et al. reference does not teach or suggest the features of the present invention including a method for driving an ink jet recording head by providing a driving voltage that has driving voltage changing times that are based upon the resonance frequency of a pressure wave generated in the pressure generating chamber.

Rather, the Iwamura et al. reference is clearly directed to correcting the driving voltage in accordance with a viscosity change in the ink depending upon a change in the ambient temperature (col. 2, lines 44-49). While the Iwamura et al. reference only briefly discusses the concept of a natural frequency, it is only in relation with the nozzle size and the ink droplet size (col. 5, lines 24-35).

Therefore, the Iwamura et al. reference clearly does not teach or suggest the features of the present invention including a method for driving an ink jet recording head by providing a driving voltage that has driving voltage changing times that are based upon the resonance frequency of a pressure wave generated in the pressure generating chamber. As explained above, this feature is important for ejecting smaller ink droplets.

Therefore, the Iwamura et al. reference does not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection of claims 18-22.

III. FORMAL MATTERS AND CONCLUSION

The Office Action objects to claims 20-22. This Amendment amends claims 20-22 in accordance with Examiner Nguyen's very helpful suggestions.

In view of the foregoing amendments and remarks, Applicant respectfully submits that claims 18-22, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

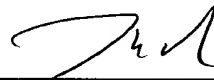
Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: _____

11/28/93



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Paper No. 70

Notice of Non-Compliant Amendment (37 CFR 1.121)

The amendment document filed on Nov. 6, 2003 is considered non-compliant because it has failed to meet the requirements of 37 CFR 1.121, as amended on June 30, 2003 (see 68 Fed. Reg. 38611, Jun. 30, 2003). In order for the amendment document to be compliant, correction of the following item(s) is required. Only the corrected section of the non-compliant amendment document must be resubmitted (in its entirety), e.g., the entire "Amendments to the claims" section of applicant's amendment document must be re-submitted. 37 CFR 1.121(h).

THE FOLLOWING CHECKED (X) ITEM(S) CAUSE THE AMENDMENT DOCUMENT TO BE NON-COMPLIANT:

- ☐ 1. Amendments to the specification:
- ☐ A. Amended paragraph(s) do not include markings.
 - ☐ B. New paragraph(s) should not be underlined.
 - ☐ C. Other _____
- ☐ 2. Abstract:
- ☐ A. Not presented on a separate sheet. 37 CFR 1.72.
 - ☐ B. Other _____
- ☐ 3. Amendments to the drawings: _____
- ☒ 4. Amendments to the claims:
- ☒ A. A complete listing of all of the claims is not present.
 - ☐ B. The listing of claims does not include the text of all claims (including withdrawn claims)
 - ☐ C. Each claim has not been provided with the proper status identifier, and as such, the individual status of each claim cannot be identified.
 - ☐ D. The claims of this amendment paper have not been presented in ascending numerical order.
 - ☒ E. Other: CLAIMS 1-17 must be mentioned as cancelled.

For further explanation of the amendment format required by 37 CFR 1.121, see MPEP Sec. 714 and the USPTO website at <http://www.uspto.gov/web/offices/pac/dapp/opla/preosnotice/officeflyer.pdf>.

If the non-compliant amendment is a **PRELIMINARY AMENDMENT**, applicant is given **ONE MONTH** from the mail date of this letter to supply the corrected section which complies with 37 CFR 1.121. Failure to comply with 37 CFR 1.121 will result in non-entry of the preliminary amendment and examination on the merits will commence without consideration of the proposed changes in the preliminary amendment(s). This notice is not an action under 35 U.S.C. 132, and this **ONE MONTH** time limit is not extendable.

If the non-compliant amendment is a reply to a **NON-FINAL OFFICE ACTION** (including a submission for an RCE), and since the amendment appears to be a *bona fide* attempt to be a reply (37 CFR 1.135(c)), applicant is given a **TIME PERIOD** of **ONE MONTH** from the mailing of this notice within which to re-submit the corrected section which complies with 37 CFR 1.121 in order to avoid abandonment. **EXTENSIONS OF THIS TIME PERIOD ARE AVAILABLE UNDER 37 CFR 1.136(a).**

If the amendment is a reply to a **FINAL REJECTION**, this form may be an attachment to an Advisory Action. The period for response to a final rejection continues to run from the date set in the final rejection, and is not affected by the receipt of this notice.

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